CLAIMS

1. A nucleic acid-adsorbing porous membrane for separating and purifying a nucleic acid, which comprises a nucleic acid-adsorbing solid phase for use in a method for separating and purifying the nucleic acid, the solid phase adsorbing the nucleic acid,

the method comprising the steps of:

(1) adsorbing the nucleic acid to the solid phase by allowing a sample solution containing the nucleic acid to come into contact with the nucleic acid-adsorbing solid phase;

(2) washing the solid phase by allowing a washing solution to come into contact with the solid phase, while the nucleic acid is adsorbed to the solid phase; and

(3) desorbing the nucleic acid from the solid phase by allowing a recovering solution to come into contact with the solid phase.

2. The nucleic acid-adsorbing porous membrane as described in claim 1, which has a thickness of 10 μm to 500 μm.

3. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 2, which has an average pore size of 0.9 to 5.0 μm.

4. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 3, which has a front surface and a back surface asymmetrical with each other.

5. The nucleic acid-adsorbing porous membrane as described in claim 4, wherein the ratio of the largest pore size to the smallest pore size is 2 or more.

6. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 5, which has a void volume of 50 to 95%.

7. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 6, which has a bubble point of 0.1 to 10 kgf/cm^2.

8. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 7, which has a pressure loss of 0.1 to 100 kPa.

9. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 8, which allows water to pass therethrough in an amount of 1 to 5000 mL per minute at a temperature of 25°C under a pressure of 1 kg/cm^2.

10. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 9, which adsorbs the nucleic acid in an amount of 0.1 μg or more per mg of the porous membrane.

11. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 10, which adsorbs the nucleic acid through an interaction involving substantially no ionic bond between the porous membrane and the nucleic acid.

12. The nucleic acid-adsorbing porous membrane as described in claim 11, wherein the porous membrane adsorbing the nucleic acid through the interaction involving substantially no ionic bond comprises an organic polymer having a polysaccharide structure.

13. The nucleic acid-adsorbing porous membrane as described in claim 12, wherein the porous membrane adsorbing the nucleic acid and comprising an organic polymer having a polysaccharide structure is a mixture of acetylcelluloses different from each other in acetyl value.

14. The nucleic acid-adsorbing porous membrane as described in claim 13, wherein the mixture of

acetylcedlluloses different from each other in acetyl value is a mixture of triacetylcellulose and diacetylcelluolse.

15. The nucleic acid-adsorbing porous membrane as described in claim 14, wherein the mixture has a triacetylcellulose/diacetylcellulose mixing rate of 99:1 to 1:99 by weight.

16. The nucleic acid-adsorbing porous membrane as described in claim 13, wherein the mixture of acetylcedlluloses different from each other in acetyl value is a mixture of triacetylcellulose and monoacetylcelluolse.

17. The nucleic acid-adsorbing porous membrane as described in claim 13, wherein the mixture of acetylcedlluloses different from each other in acetyl value is a mixture of triacetylcellulose, diacetylcellulose and monoacetylcelluolse.

18. The nucleic acid-adsorbing porous membrane as described in claim 13, wherein the mixture of acetylcedlluloses different from each other in acetyl value is a mixture of diacetylcellulose and monoacetylcelluolse.

19. The nucleic acid-adsorbing porous membrane as described in claim 12, wherein the porous membrane comprising the polymer having the polysaccharide structure is a porous membrane comprising an organic material obtained by saponification of acetylcellulose or acetylcelluloses.

20. The nucleic acid-adsorbing porous membrane as described in claim 19, wherein saponification ratio of the acetylcellulose(s) is 5% or more.

21. The nucleic acid-adsorbing porous membrane as described in claim 20, wherein the porous membrane comprising the organic material obtained by saponification of the acetylcellulose(s) is a porous membrane comprising an organic material obtained by saponification of a mixture of acetylcelluloses different from each other in acetyl value.

22. The nucleic acid-adsorbing porous membrane as described in claim 21, wherein the mixture of acetylcelluloses different from each other in acetyl value has a saponification ratio of 5% or more.

23. The nucleic acid-adsorbing porous membrane as described in claim 21 or 22, wherein the organic

material obtained by saponification of a mixture of acetylcelluloses different from each other in acetyl value is a saponification product of a mixture of triacetylcellulose and diacetylcellulose.

24. The nucleic acid-adsorbing porous membrane as described in claim 23, wherein the triacetylcellulose/diacetylcellulose mixing ratio is 99:1 to 1:99 by weight.

25. The nucleic acid-adsorbing porous membrane as described in claim 21 or 22, wherein the organic material obtained by saponification of a mixture of acetylcelluloses different from each other in acetyl value is a saponification product of a mixture of triacetylcellulose and monoacetylcellulose.

26. The nucleic acid-adsorbing porous membrane as described in claim 21 or 22, wherein the organic material obtained by saponification of a mixture of acetylcelluloses different from each other in acetyl value is a saponification product of a mixture of triacetylcellulose, diacetylcellulose and monoacetylcellulose.

27. The nucleic acid-adsorbing porous membrane as

described in claim 21 or 22, wherein the organic material obtained by saponification of a mixture of acetylcelluloses different from each other in acetyl value is a saponification product of a mixture of diacetylcellulose and monoacetylcellulose.

28. The nucleic acid-adsorbing porous membrane as described in any one of claims 19 to 27, wherein the average pore size after saponification is reduced to that before saponification.

29. The nucleic acid-adsorbing porous membrane as described in claim 28, wherein the ratio of the average pore size after saponification to that before saponification is 0.8 or less.

30. The nucleic acid-adsorbing porous membrane as described in claim 12, wherein the organic polymer having a polysaccharide structure is a regenerated cellulose.

31. The nucleic acid-adsorbing porous membrane as described in claim 11, wherein the porous membrane adsorbing the nucleic acid through the interaction involving substantially no ionic bond is a porous membrane obtained by treatment of a porous membrane of a

hydrophilic group-free organic material so as to introduce a hydrophilic group into the porous membrane.

32. The nucleic acid-adsorbing porous membrane as described in claim 31, wherein the treatment of the porous membrane of a hydrophilic group-free organic material comprises binding to the porous membrane, a graft polymer chain having a hydrophilic group in the polymer chain or side chain thereof.

33. The nucleic acid-adsorbing porous membrane as described in claim 11, wherein the porous membrane adsorbing the nucleic acid through the interaction involving substantially no ionic bond is a porous membrane obtained by coating a porous membrane of a hydrophilic group-free organic material with a material having a hydrophilic group to thereby introduce a hydrophilic group into the porous membrane.

34. The nucleic acid-adsorbing porous membrane as described in claim 33, wherein the material having a hydrophilic group is an organic polymer having a hydrophilic group in the polymer chain or the side chain thereof.

35. The nucleic acid-adsorbing porous membrane as

described in claim 11, wherein the porous membrane adsorbing the nucleic acid through the interaction involving substantially no ionic bond is an inorganic material where a material for forming the porous membrane itself has a hydrophilic group.

36. The nucleic acid-adsorbing porous membrane as described in claim 11, wherein the porous membrane adsorbing the nucleic acid through the interaction involving substantially no ionic bond is a porous membrane obtained by treatment of a porous membrane of a hydrophilic group-free inorganic material so as to introduce a hydrophilic group into the porous membrane.

37. The nucleic acid-adsorbing porous membrane as described in claim 36, wherein the treatment for introducing the hydrophilic group into the hydrophilic group-free inorganic material comprises binding to the porous membrane, a graft polymer chain having a hydrophilic group in the polymer chain or side chain thereof.

38. The nucleic acid-adsorbing porous membrane as described in claim 11, wherein the porous membrane adsorbing the nucleic acid through the interaction involving substantially no ionic bond is a porous

membrane obtained by coating a porous membrane of a hydrophilic group-free inorganic material with a material having a hydrophilic group to thereby introduce a hydrophilic group into the porous membrane.

39. The nucleic acid-adsorbing porous membrane as described in claim 38, wherein the material having a hydrophilic group is an organic polymer having a hydrophilic group in the polymer chain or side chain thereof.

40. The nucleic acid-adsorbing porous membrane as described in any one of claims 31 to 39, wherein the hydrophilic group is a hydroxyl group.

41. The nucleic acid-adsorbing porous membrane as described in any one of claims 1 to 40, wherein the sample solution containing the nucleic acid, the washing solution and the recovering solution are passed, in the step (1), step (2) and step (3), respectively, through the nucleic acid-adsorbing porous membrane under pressure.

42. The nucleic acid-adsorbing porous membrane as described in claim 41, which is used in the method for separating and purification the nucleic acid,

wherein the sample solution containing the nucleic acid, the washing solution and the recovering solution is injected, in the step (1), step (2) and step (3), respectively, through a first opening of a cartridge for separating and purifying the nucleic acid, in which the cartridge comprises at least two openings including the first opening and a second opening; and

inside of the cartridge is made in a pressurized state with a pressure difference-generating apparatus attached to the first opening, so as to pass each of the sample solution containing the nucleic acid, the washing solution and the recovering solution through the porous membrane and to discharge each of the sample solution containing the nucleic acid, the washing solution and the recovering solution from the second opening.

43. A cartridge for separation and purification of nucleic acid, which comprises: a container including at least two openings including a first opening and a second opening; and a nucleic acid-adsorbing porous membrane described in any one of claims 1 to 42, the porous membrane being received in the container.

44. The cartridge for separation and purification of nucleic acid as described in claim 43, wherein a pump as a pressure difference-generating apparatus is

removably attached to the first opening of the cartridge for separation and purification of nucleic acid.

45. A kit comprising: a cartridge for separation and purification of nucleic acid, the cartridge comprising a nucleic acid-adsorbing porous membrane described in any one of claims 1 to 42; and a reagent.

46. An apparatus for separation and purification of nucleic acid, which uses a nucleic acid-adsorbing porous membrane described in any one of claims 1 to 42.

47. The apparatus for separation and purification of nucleic acid as described in claim 46, which is an automated apparatus automatically carrying out steps of separation and purification of nucleic acid, the steps including: adsorbing a nucleic acid in a sample solution to the nucleic acid-adsorbing porous membrane by injecting the sample solution containing the nucleic acid into a cartridge for separation and purification of nucleic acid, the cartridge comprising the nucleic acid-adsorbing porous membrane, under pressure; injecting a washing solution into the cartridge for separation and purification of nucleic acid under pressure to remove other ingredients than the nucleic acid, while the nucleic acid is adsorbed to the nucleic acid-adsorbing

porous membrane; and injecting a recovering solution into the cartridge for separation and purification of nucleic acid under pressure, to desorb the nucleic acid adsorbed to the nucleic acid-adsorbing porous membrane and recover the nucleic acid together with the recovering solution;

wherein the apparatus comprises:

a mechanism of holding: the cartridge for separation and purification of nucleic acid; a waste liquor container for containing a discharged solution of the sample solution and the washing solution; and a recovery container for containing the recovering solution containing the nucleic acid;

a mechanism of feeding a pressure air into the cartridge for separation and purification of nucleic acid; and

a mechanism of separately injecting the washing solution and the recovering solution into the cartridge for separation and purification of nucleic acid.

48. The apparatus for separation and purification of nucleic acid as described in claim 47, wherein the holding mechanism comprises: a stand mounted on a body of the apparatus; a cartridge holder vertically movably supported on the stand and holding the cartridge for separation and purification of nucleic acid; and a

holder for holding the waste liquor container and the recovering container at a position below the cartridge holder so that the relative position with respect to the cartridge can be exchanged.

49. The apparatus for separation and purification of nucleic acid as described in claim 47 or 48, wherein the pressure air-feeding mechanism comprise: an air nozzle for jetting pressure air from the lower edge portion; a pressure head for supporting and vertically moving the air nozzle with respect to the cartridge for separation and purification of nucleic acid held in the cartridge holder; and a positioning means provided on the pressure head, the positioning means being for positioning the cartridge for separation and purification of nucleic acid in a rack of the holding mechanism.

50. The apparatus for separation and purification of nucleic acid as described in any one of claims 47 to 49, wherein the separately injecting mechanism comprises: a washing solution-injecting nozzle for injecting the washing solution; a recovering solution-injecting nozzle for injecting the recovering solution; a nozzle-shifting rack holding the washing solution-injecting nozzle and the recovering solution-injecting

nozzle and capable of migrating in sequence over the cartridges for separation and purification of nucleic acid held by the holding mechanism; a washing solution-feeding pump for sucking the washing solution from a bottle containing the washing solution and feeding the washing solution to the washing solution-injecting nozzle; and a recovering solution-feeding pump for sucking the recovering solution from a bottle containing the recovering solution and feeding the recovering solution to the recovering solution-feeding nozzle.